Increasing the Symmetry of Epitaxial Clouds via Pre-Granulation and Acoustic Energy Injection

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Introduction

Many factors affect the quality of epitaxial vapor clouds and the inability to finely control the quality of these clouds is a limiting factor in the manufacture of microelectronic components.

Natural asymmetries can result from variations in the density of the semiconductor wafer, power level of the LASER used and unpredictable conversion of photonic energy into electrical flow, resulting in magnetic turbulence. It is the latter of those three which has proven the most difficult address.

Abstract

When a LASER strikes a wafer of semiconductor in an epitaxial process, the properties of the semiconductor result in the conversion of some portion of the photonic energy into electrical current, which results in an unseen magnetic field. This magnetic field is asymmetrical and is similar to that of the magnetic field generated by cloud-to-cloud lightning. Instead of traveling through clouds, these nano- scale currents travel through a semiconductor over short distances. The pattern of current flow is; like lightning; unique in each instance and, therefore, the ejecta resulting from each LASER pulse have correspondingly unpredictable asymmetries. These asymmetries force the manufacturers of semiconductor chips to waste material and limits the speed with which chips can be manufactured.

If acoustic energy were to be introduced to the precise point at which the LASER is expected to strike a surface, the positional interrelationships between the individual atoms could be randomly varied over time. Current, rather than finding its ideal path of least resistance, would set out on an initial path dictated by what the path of least resistance *would have been* given the original state of the system. Because the system will change slightly but unpredictably in its configuration in the time it takes for the discharge to occur, the current will be met with greater than expected resistance and will be inhibited. Additionally, it would be forced to branch out into a greater diversity of paths, resulting in a more symmetrical magnetic field. This, in turn, would produce a more symmetrical epitaxial cloud.

This effect would be maximized if the wafer material could somehow be made to be as brittle as possible. The most practical way to realize this would be to render the wafer material as an atomically granulated powder prior to the epitaxy process. This would allow the material to be moved by the applied acoustic energy in order to bring about the desired effect. Because the material is already separated (a literal atomization normally accomplished through the epitaxy process,) a far greater degree of symmetry could be

achieved as there would be no molecular-level electromagnetic energy accumulation in individual “chunks” of metal during the process of atomization.

The most efficient configuration of a LASER pulse, particularly using this new strategy, would be to use a pulse which projects a ring-shaped area of light upon a wafer around the area which one wishes to be the central point of emission of ejecta, rather than using a point focus. This would allow for the ejecta, itself, to form a type of parallax at which the ejecta would be ideally focused at a particular distance from the point of emission.

Conclusion

By eliminating magnetic field asymmetries through pre-granulation of the wafer material and application of acoustic energy to the wafer and through the use of a ring-shaped area of focus of LASER light, the symmetry of epitaxial ejecta clouds can be greatly enhanced, thereby increasing the efficiency of microelectronics manufacture.